DEPARTMENT OF THE INTERIOR U. S. Geological Survey UNITED STATES GEOLOGICAL SURVEY OPEN FILE REPORT EXPLANATION SURFICIAL DEPOSITS  $N \ O \ R \ T \ O \ N$ |S O U N D||Floodplain, beach, and wind-blown silt deposits CONSOLIDATED DEPOSITS a . Undeformed basalt flows North Point ∷gr⊹ STUART ISLAND Egg Island Porphyritic and nonporphyritic granitic rocks Moderately deformed andesite and basalt flows :::c:::: Interbedded sandstone, shale, and siltstone d Interhedded volcanic and sedimentary rocks The Sistors Chiefly greenstone, quartzite, chert, and limestone; includes of many small intrusives in Mt. Okumiat area Point Romar PASTOL Contact Kothlik Island Dashed where approximately located or inferred + F Fossil locality 0 100 200 MILES INDEX MAP OF ALASKA, SHOWING LOCATION OF AREA DISCUSSED IN THIS REPORT Kuksukalik Anakshek Pass Ingrichous His Krekatok Island Sand Islands Neragon Island Cape Romanzof Dall Point Base map from U. S. Geological Survey, 1:1,000,000 Geology mapped in 1960 and 1961 International Map of the World, Bethel NP-3, 4

PRELIMINARY GEOLOGIC MAP OF LOWER YUKON-NORTON SOUND REGION, ALASKA

40 MILES

J.M.Hoare and W.H.Condon SCALE 1:500 000 10 0

This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards

OPEN FILE MAP Glaska 700, 134

One Sheet only - no separate text

1962 MAGNETIC DECLINATION OF SOUTH EDGE OF MAP RANGES FROM 16° TO 19°45' EAST

1962

INTRODUCTION

This is a preliminary report of geologic investigations in the lower Yukon-Norton Sound region, Alaska. It is based upon information obtained on a boat traverse of the lower Yukon in 1960 and by use of a helicopter in 1961. The study of vertical airphotos vielded much information which was useful in guiding the field work and compiling the geologic map.

Fossil identifications are by Ralph W. Imlay, David L. Jones, and Jack A. Wolfe, of the U.S. Geological Survey.

BEDDED ROCKS Bedded rocks ranging in age from Paleozoic to late Cenozoic crop out widely in the eastern half of the mapped area and at a few places farther west where thick unconsolidated deposits of Quaternary age cover most of the bedrock. For mapping purposes the bedded strata are divided into five units. These units are primarily lithologic rather than stratigraphic because at the present stage of investigation it is not possible to correlate some of the strata with much assurance. However, the probable age of most of the strata, based partly on fossil evidence and partly on apparent stratigraphic position, is indicated where known.

The rocks of unit e crop out in the vicinity of Marshall and extend eastward beyond the limits of the area mapped for this report. They consist of massive greenstone formed by the alteration of mafic volcanic rocks which is interbedded with chert, quartzite, pebble conglomerate, graywacke, dark argillitic rocks, and limestone. Between Marshall and he Kuyukutuk River and in the vicinity of Mt. Okumiat the unit is intruded by a large stock of biotite granite and numerous small bodies of dacite and rhyolite. In the vicinity of the intrusive bodies the rocks of unit e are metamorphosed to epidote-bearing amphibolite. quartz-biotite-muscovite schist, and chlorite-talc schist. The thickness and stratigraphic sequence of the unit is not known because the strata are compressed into tight folds and broken by many faults. No fossils were found in these rocks in the area covered by this report but they are assumed to be of Permian age because they are in part lithologically similar to and strike toward fossiliferous limestone of Permian age a few miles farther east. They were mapped as Carboniferous by Harrington (1918, p. 23-26, pl. 3) who also correlated them with the rocks of Permian age which crop out farther up the Yukon.

Unit d crops out near the east edge of the area mapped for this report from the Yukon River northward, in the valley of the Chuilnak River, and south of Norton Sound in the vicinity of the Pastolik River. The strata consist of basalt, andesite, and trachyte lava flows, tuffs, breccia, volcanic wacke, and minor amounts of interbedded limestone and argillaceous sediments. At least 10,000 feet of these rocks crop out along the Yukon above and below Ohogamut Village. Four small collections of fossils were obtained from these strata north of Ohogamut David L. Jones reports that one collection consists of pelecypods (Buchiz crassicolis or sublaevis of Early Cretaceous (Neocomian) age. The other ctions consist of ammonite fragments and belemnites which Ralph W. Imlay reports are probably of Jurassic age. No fossils or sedimentary rocks have been found associated with the volcanic rocks in the valley of the Chuilnak River or south of Norton Sound near the Pastolik River. The volcanic rocks in both of these areas are tentatively correlated with the fossiliferous strata on the Yukon, on the basis of lithologic simi-

Unit c is made up of sedimentary rocks that crop out at intervals along the Yukon from the vicinity of Pilot Station to Mountain Village and extend northeast parallel to the Andreafsky and Chuilnak Rivers. The unit also crops out on Cape Romanzof and forms most of the Kusilvak

The rocks consist of medium- to dark-gray sanistone interbedded with equal or greater amounts of siltstone. Locally the siltstone is quite shaly. Conglomeratic strata were noted in only one place. Most of the sandstone is graywacke consisting of mixtures of angular and rounded clasts in a fine-grained matrix. It commonly contains carbonized plant trash and locally shows faint ripple marks. small-scale crossbedding, and other evidence of near-shore, shallow water deposition Several collections of fossils consisting of mollusca and plants were obtained from these rocks. The fossil plants, which were obtained on the Yukon about a mile below Pilot Station and at three places on the East Fork of Andreafsky River, were examined by Jack A. Wolfe, who reports that they are late Early or early Late Cretaceous (Albian or Cenomanian) age. Two collections of pelecypods were obtained near the mouth of the Andreafsky River, a third on a ridge crest about 5 miles northwest of Pilot Station, and three others on the East Fork of Andreafsky River. The collections were examined by David L. Jones who reports that the first two collections are of late Early Cretaceous (Albian) age; the remaining four collections consist of fresh water forms (Unio sp.) which are not diagnostic of age. However, the collections of fresh water forms were obtained from the same strata s as the fossil plants identified by Wolfe as late Early Cretaceous or early Late Cretaceous age. As all fossil collections were obtained from the lower part of the unit, unit c may include rocks of Late Cretaceous age as well as Albian age. North of the Yukon River the rocks of unit c can be subdivided into three groups of strata on the basis of whether the sandstones are

chiefly calcareous, noncalcareous, or laumontite-bearing. The relative age of these three groups of strata is uncertain because the rocks are highly deformed and poorly exposed. The three groups of strata form seven fairly well defined belts of rock that trend northeastward parallel to the regional strike. Some of the belts extend from the Yukon northeastward beyond the area mapped for this report; others appear to pinch out in a distance of 15 to 20 miles. The stratigraphic and structural relationships of the belts are uncertain. Some of them may be separated by faults; others may crop out in the axis or on the limbs of gently plunging folds. The belts are not shown on the small-scale base map because it lacks sufficient detail to locate them accurately. Laumontite-bearing sandstone characterizes a broad belt of rocks that splits into two belts about 20 miles north of the Yukon. The laumontite sandstone is interbedded with lesser amounts of noncalcareous gray sandstone, and with equal or greater amounts of siltstone and shale. It is medium to dark gray and blotched with light- to medium gray spots. In some strata the light-colored spots or blotches are surrounded by larger areas of darker colored rock and the rock has a speckled appearance. Elsewhere the light-colored areas appear to have joined and make up most or all of the rock with little or none of the darker rock left. X-ray and thin-section analyses show that both the light and dark-colored parts contain a large amount of the calcic zeolite laumontite as the chief cementing material. The fact that the lightcolored blotches are commonly spherical or ovoid probably reflects the tendency of laumontite to crystallize as spherical clusters of radiating

Noncalcareous, dark-gray, and greenish-gray sandstones characterize two of the belts. The sandstone is interbedded with equal or greater amounts of siltstone and, locally, with small amounts of calcareous sandstone. The noncalcareous sandstone is well indurated and occurs in beds ranging in thickness from an inch to more than a foot. Locally, as downstream from Pilot Station, sandstone forms massive beds several

The fossil plants and mollusca found in unit c are associated with the noncalcareous sandstones. They indicate that the rocks were deposited under near-shore marine and nonmarine conditions.

Highly calcareous gray sandstone interbedded with equal or greater amounts of noncalcareous siltstone comprise three of the belts. Locally the calcareous sandstones grade into sandy limestone. At least two 10to 20-foot beds of cobble conglomerate are interlayered with the thinpedded calcareous sandstone that forms Point Romanzof on the south shore of Norton Sound. Except for shale-chip conglomerate and a few thin layers of pebble grit, these are the only conglomeratic rocks noted in unit c. The calcareous rocks weather various shades of brown and characteristically split parallel to the bedding into sheets less than 2 inches thick. Hills and ridges formed on the calcareous rocks are generally smoothly rounded and surmounted by numerous isolated conical points and ribs a few feet high.

West of the Yukon River the strata of unit c crop out in the Kusilvak Mountains and on Cape Romanzof. In both areas the rocks are baked and altered to hornfels by bodies of intrusive rocks. On Cape Romanzof where the rocks are highly altered, no calcareous sandstones were noted. In the Kusilvak Mountains, where the rocks are generally less altered, both calcareous and noncalcareous strata were noted. No laumontite-bearing sandstone was noted at either place. It is probable that the sedimentary rocks west of the Yukon are part of the westernmost belt of noncalcareous rocks which locally includes some calcareous sandstone.

Unit b consists of moderately deformed andesite and basalt flows that crop out near the headwaters of the Nageethluck River. The rocks are mostly porphyritic dark gray or black and are commonly vesicular and amygdaloidal. Some of the flows are propylitized but they are less altered than the volcanic rocks in unit d. The olivine noted in one flow is partly altered to serpentine; the glassy matrix in some of the flows is somewhat devitrified. Many of the flows show a well-developed platy parting parallel to the flow planes, which commonly dip 10° to 20° northward, and locally dip as much as 50°.

The flows are thought to be of Tertiary or possibly Late Cretaceous age because they are more deformed and altered than flows of Quaternary age and less deformed and altered than rocks mapped as unit d of Meso-

Unit a consists largely of horizontal and near-horizontal flows of vesicular olivine basalt which crop out on Stuart Island, along the south shore of Norton Sound, at Russian Mission on the Yukon and south of Mt. Okumiat, and at many places west of the Yukon. On Stuart Island the flows are closely associated with at least 100 feet of well-bedded, poorly consolidated, gray and yellow volcanic crystal ash. The source of many individual flows can be traced to local volcanic vents which are cone-shaped and commonly rise several hundred feet above the surrounding terrane. Craters within the cones range from shallow depressions to steep-sided holes up to 100 feet deep. Most of the flows appear to be between 10 and 30 feet thick, and few of them appear to be

more than 10 miles long. The flows and associated tuffs are thought to be of Quaternary age because they are undeformed and fresh-appearing. That they were extruded over a considerable period of time is evident from the fact that the younger flows retain their original surficial flow features and are free of vegetation except for a few lichens; the older flows are deeply dissected, covered with vegetation, and, locally, with silt deposits. Some of the older flows may be broken by faults.

INTRUSIVE ROCKS

Intrusive igneous rocks are chiefly granitic and rhyolitic but include a few dikes and sills of mafic rocks. Strata ranging in age from late Paleozoic to late Mesozoic and possibly Tertiary (unit b) are intruded by the igneous rocks, so some of them. at least, are as young as Late Cretaceous or Tertiary. The fact that granite pebbles are common in conglomerate of Cretaceous age farther east suggests that some of the granitic bodies may be of pre-Cretaceous or very Early Cretaceous age. The chief areas of intrusive activity are the Askinuk Mountains. Kusilvak Mountains, Mt. Okumiat, Pilcher Mountain, north of the Kuyukutuk River, west of Kako Creek, the Wolf Creek Mountains, and near the headwaters of the East Fork of Andreafsky River. Several small bodies f intrusive rocks have been omitted from the geologic map owing to

Preliminary study of the intrusive rocks indicates that they are of two general groups. The first group consists of gray, medium-grained biotite granite and hornblende granodiorite. The second group consists of fine-grained, porphyritic gray rhyolite and rhyodacite. The Askinuk Mountains and the slopes of Pilcher Mountain are formed on granitic rocks of the first group. The top of Pilcher Mountain consists of contact-metamorphosed greenstones. The Kusilvak Mountains are formed chiefly on baked, slightly metamorphosed sedimentary rocks of unit c. which are intruded by fine-grained, porphyritic rhyolite and dacite dikes and sills. The porphyritic rocks are probably apophyses from an underlying granite body, because the widespread baking of the sedimentary rocks cannot be attributed to the porphyritic rocks which crop out mostly near the north side of the mountains.

The Askinuk Mountains consist mostly of medium- to coarse-grained gray granodiorite. Locally the granodiorite contains dark-gray finegrained inclusions or segregations and is cut by fine-grained gray porphyritic dikes 10 to 20 feet thick. The dikes appear to be dacite. The granodiorite and associated dikes intrude interbedded sandstone and siltstone of Cretaceous age (unit c) which form most of Cape Romanzof. The sedimentary rocks are recrystallized to hornfels. Intrusive rocks near the upper part of the East Fork of Andreafsky River are chiefly fine-grained gray porphyritic rhyolite, rhyodacite. and diorite. Fine- to medium-grained biotite-hornblende diorite forms one or more plug-like intrusive bodies about a mile in diameter. Rhyolite and rhyodacite form numerous sheet-like intrusive bodies which range in thickness from a few feet to many hundreds of feet. Some of the thicker sheets extend 10 to 15 miles parallel to the strike of the enclosing sedimentary rocks. They are locally concordant but commonly dip more steeply than the enclosing rocks. Locally some of the sheets appear to widen into dome-shaped bodies a mile or more in diameter. The country rocks, chiefly calcareous sandstone and shale, show little or no metamorphism near these intrusive rocks.

Hydrothermally altered mineralized light gray and buff-colored rhyolite makes up a stock about 4 miles in diameter in the Wolf Creek Mountains. The rhyolite was examined at one place on the west side of the mountains and found to be hydrothermally altered and heavily pyritized. A conspicuous iron-stained area on the east side of the stock is formed on hydrothermally altered rhyolite containing specularite. The extent of the hydrothermal alteration and mineralization is not yet known. The rhyolite intrudes andesitic lava flows which are slightly altered by contact metamorphism. Altered andesite forms most of the ridge crests and peaks. Rhyolite underlies the valleys and

The rhyolite consists of a microcrystalline matrix of quartz and feldspar in which crystals of apatite, zoisite, pyrite, and, locally, specular hematite are embedded. The matrix is largely altered to scaly micaceous minerals. A few relict feldspar phenocrysts are discernible under the microscope. The fact that this intrusive body of rhyolite is surrounded by a

metamorphic aureole at least a mile wide and that essentially no metamorphic effects were noted near the large rhyolite bodies on the East Fork of the Andreafsky River is somewhat anamolous. Possibly the rhyolite in the Wolf Creek Mountains is a felsic border facies of an underlying granite body which is not exposed at the present erosion level. Dacite and rhyodacite fragments are the chief constituents of patches of frost rubble over an area of at least 30 square miles north of the Kuyukutuk River. On the geologic map they are shown as a

single intrusive body but they may form several small bodies. Most of the rocks are light to medium gray, fine grained, and porphyritic. The felsic matrix appears to be largely orthoclase and quartz, the phenocrysts are chiefly plagioclase (oligoclase and andesine), biotite and hornblende. Rounded, embayed quartz phenocrysts occur in some of the rocks, but others contain no modal quartz and are probably diorite. In general the rocks of this intrusive body do not appear to be as much altered as they are in the vicinity of Mt. Okumiat except along the west edge of the body where the rocks are silicified and

The intrusive rocks are bordered on the west by metamorphosed rocks of late Paleozoic age (unit e) and on the east by metamorphosed rocks of Mesozoic age (unit d). The metamorphosed Mesozoic rocks are chiefly orphyroblastic hornfels developed from siltstone and volcanic wacke. The Paleozoic rocks west of the intrusive body are chiefly mafic lava flows and quartzite. Near the contact the lava flows are altered to zoisite or clinozoisite amphibolite and the quartzite has porphyroblastic orthoclase. The lava flows of possible Late Cretaceous or Tertiary age (unit b) that crop out north of the intrusive rocks do not appear to be altered. The nature of their contact with the intrusive rocks is not known because it is concealed by alluvial cover.

In the vicinity of Mt. Okumiat the intrusive rocks consist of numerous dikes that range in thickness from 5 feet to several hundred feet. They are not shown on the geologic map because of their small size. The attitude of the dikes is poorly known because they crop out only as frost rubble, but they appear to trend generally east-west and dip steeply.

Preliminary study of the dike rocks indicates that they are hydrothermally altered. They are gray, fine to medium grained, and commonly have a sugary appearance. The original minerals are partly or entirely replaced by sericite, chlorite, carbonate, and quartz. The original composition of the rocks is uncertain but most of them are probably altered granite or granodiorite porphyry. The dikes intrude greenstone graywacke, conglomerate, and argillitic rocks of unit e, all of which are silicified, recrystallized, and locally, pyritized. The placer gold deposits in the vicinity of Mt. Okumiat were probably derived from these altered rocks.

A moderate-sized intrusive body west of Kako Creek consists of porphyritic rocks similar to but less altered than the dike rocks in the vicinity of Mt. Okumiat. Much of the rock is a granoblastic mosaic of quartz and orthoclase with abundant phenocrysts of plagioclase and less abundant phenocrysts of green hornblende and rounded resorbed quartz. Epidote, chlorite, sericite, and sphene are common secondary minerals A metamorphic aureole of baked and recrystallized greenstones at least one-half mile wide surrounds the intrusive body. No metallic minerals other than magnetite were noted in the intrusive or metamorphic rocks. However the placer gold mine which was formerly operated at the east end of the intrusive body shows that some of the rocks are

Surficial deposits comprise unconsolidated deposits of silt. sand, and gravel of Quaternary age. They include older terrace gravels and silt of Pleistocene age and Recent flood-plain alluvium and beach de-

Unconsolidated deposits are most extensively developed along the south shore of Norton Sound from St. Michael southwestward and west and south of the Yukon River. North of the Yukon the deposits are best developed near the mouths of large tributary streams such as the Chuilnuk and Andreafsky Rivers.

The deposits contain quantities of brown peat in layers that are commonly several feet thick. Much of the peat and most of the older silt deposits are permanently frozen. The thickness of the deposits varies from a few inches on bedrock hills to many hundreds of feet far out on the

- In some areas the finer grained deposits have been reworked by wind action. Extensive deposits of windblown silt occur a few miles south of the Yukon. South and west of the town of Russian Mission windblown silt mantles the hills and ridges to a height of at least 500 feet above the level of the Yukon River.

Harrington, G. L., 1918, The Anvik-Andreafski region, Alaska: U.S. Geol. Survey Bull. 683, 70 p.